

INTERNSHIP PROPOSAL

(One page maximum)

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Thesis possibility after internship: YES

New quantum sensor concepts for measuring gravity on antihydrogen

The sensitivity of matter waves to forces has made it possible for several years to build highly accurate quantum inertial sensors. To do this, an atomic interferometer is used, created by separating a wave packet through the interaction of ultra-cold atoms with a laser. Although extremely precise, these techniques are not applicable to all atoms. However, it is vital to be able to carry out an extremely precise measurement of gravity on antimatter, as such a measurement could provide an answer to the unexplained problem of the asymmetry between matter and antimatter in the universe. To this end, several experiments, based on the classical falling of atoms, are being built at CERN.

For several years now, the Kastler Brossel laboratory has been studying the possibility of using the quantum bounce of an atom, thanks to the Casimir Polder potential, to produce atomic interference and a precise measurement of gravity. Until now, models have neglected surface losses. We want to take them into account and calculate their effect on the interference.

This theoretical project will be based mainly on numerical simulations and analytical models. Statistical studies (Monte-Carlo simulation, evaluation of Fisher information) may be used to study the ultimate limits, given that the resource of anti-hydrogen atoms is very limited.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: NO Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: YES